Small Business Innovation Research/Small Business Tech Transfer

Nanotechnology based X-ray Detectors for Space Observations, Phase I

Completed Technology Project (2018 - 2019)

Project Introduction

X-Ray detector technologies that possess improved number of readout pixels, lower power, faster readout rates, greater quantum efficiency, and enhanced energy resolution are critical to space exploration and scientific research missions. This proposal identifies a transformative new approach for X-ray detection using ion-sensitive nanomaterials. Recent work has shown that certain nanomaterials are extremely sensitive to ionized gas molecules, which enables them to detect even individual ions. These sensors can be utilized as a core element within an ionizable gas-filled volume that responds strongly to X-Rays. This project proposes to develop self-standing X-Ray detector elements with higher quantum gain with reduced power consumption compared to conventional X-Ray detectors, without sacrificing readout speed and miniaturizability. This development will be carried out by an optimization of the ion-sensing core nanomaterial, the sensing geometry, and the ionizable front-end gas volume architecture. These optimized materials and architectures will be combined with low-power fast readout electronics at the back-end to form self-standing X-Ray detector elements. This project will combine the state-of-the-art in materials science, physics, detector technology, and electrical engineering to address an issue of enormous scientific importance and technical value. The successful development of such a detector element will enable the project to move into phase II, where prototype solar X-ray detectors with small independent pixels (< 250 μm) and fast read-out (>10,000 count/s/pixel) over an energy range from < 5 keV to 300 keV will be developed. This technology will have the reach to influence a number of NASA missions beyond Solar observation, such as deep-space imaging and navigation. It will also have a huge potential for commercial applications in industrial testing and process control, medical diagnostics, and advanced scientific research in materials science and beyond.

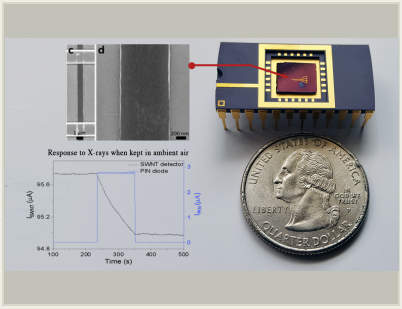
Anticipated Benefits

The proposed work will eliminate high-voltage requirements and reduce power consumption, reduce payload, and enable nanometer size pixels. Combined, these advancements will enable:

- High-density arrays for X-ray astrophysics (imaging and spectroscopy)
- Low keV sensors for solar flare monitoring
- XNAV for Pulsars for autonomous navigation

Sensitive, small form-factor, low-power, and low-cost X-ray detectors have a tremendous amount of commercial applications:

- Imaging applications in medical, industrial, and defense sectors
- Fundamental research around X-rays analysis of material science, and space



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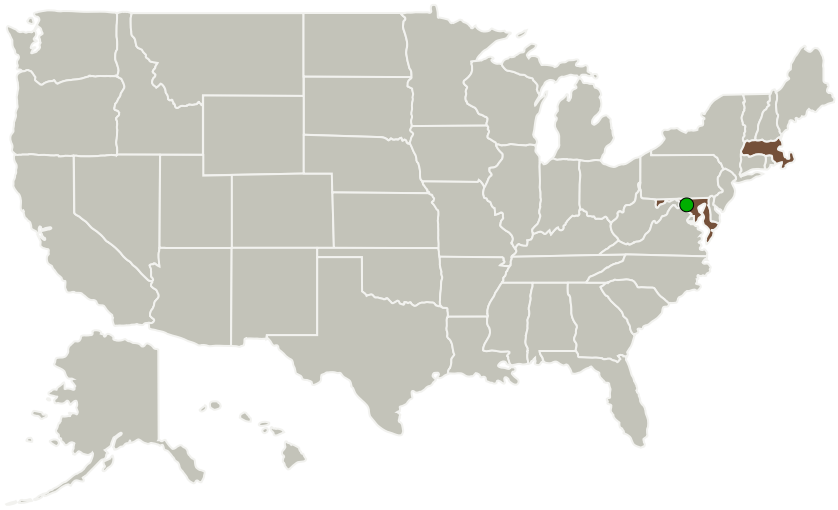
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Guardion, Inc.	Lead Organization	Industry	Boston, Massachusetts
Goddard Space Flight Center(GSFC)	Supporting Organization	NASA Center	Greenbelt, Maryland

Primary U.S. Work Locations	
Maryland	Massachusetts

Project Transitions

July 2018: Project Start

February 2019: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/141198)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Guardion, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

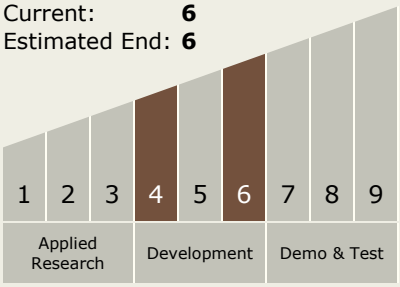
Carlos Torrez

Principal Investigator:

Daniel M Esposito

Technology Maturity (TRL)

Start: **4**
Current: **6**
Estimated End: **6**



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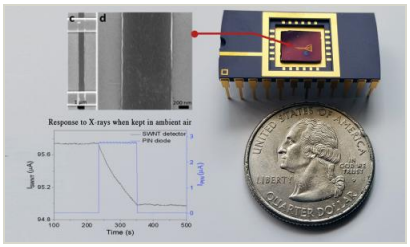
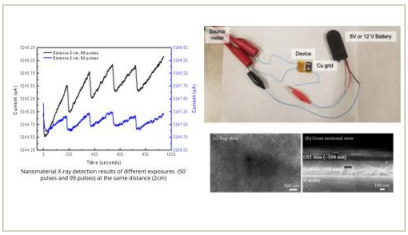
Images



Briefing Chart Image
Nanotechnology based X-ray Detectors for Space Observations, Phase I
(https://techport.nasa.gov/image/130293)



Final Summary Chart Image
Nanotechnology based X-ray Detectors for Space Observations, Phase I
(https://techport.nasa.gov/image/134020)

Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors
    - TX08.1.1 Detectors and Focal Planes

Target Destinations

The Sun, Earth, Others Inside the Solar System